OPERATING INSTRUCTIONS AND SPECIFICATIONS

for

Varian Model E5083M Cryogen Monitor

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CONTENTS

1. SAFETY

Caution, refer to accompanying documents

1. WARNING - Isolate or disconnect equipment from mains supply before opening this unit for any reason. LIVE PARTS INSIDE.

2. WARNING – This equipment must be connected to an earthed mains supply. For continued protection against risk of fire or electric shock, replace fuses with the same type, rating and UL listing.

3. This equipment is not suitable, and must not be used in areas with flammable mixtures.

4. This equipment does not need to be sterilized or disinfected

5. The equipment case and front panel may be cleaned with a non-abrasive non water based cleaner.

6. The equipment may be stored or installed within the following environmental conditions:

Ambient temperature range	:	5°C to 40°C
Relative humidity range	:	30% to 95% non-condensing
Atmospheric pressure	:	700 hPA to 1060hPA

7. The unit contains an internal lithium battery that should not be removed or changed other than by Magnex trained personnel.

8. There are no consumable parts associated with the instrument nor is there any preventative inspection or maintenance associated with the operation of the instrument

9. There are no user maintainable parts within the instrument and should the unit require repair then it should be returned to Magnex Scientific Ltd at the address shown in Section 2.

10. This equipment should not be moved after installation and connection to a magnet.

11. This equipment has been tested to meet the EMC requirements of EN60601-1-1-2:2001, EN60601-1-1-2:2000 (covering USA and Canada requirements) and the equipment should be sited such that electromagnetic interference generated by this equipment equal to or less than the limits in these standards cause no detrimental effects to surrounding equipment and that electromagnetic interference generated by the surrounding equipment is less than limits in these standards to ensure this equipment remains immune to this interference.

2. IMPORTANT NOTICE

Please inspect goods immediately on arrival for possible transit damage and notify Magnex Scientific Limited within 3 days of receipt of goods.

Failure to do this will invalidate any possible claim.

DISCLAIMER

Every precaution has been taken in the preparation of this publication.   Magnex Scientific Limited assumes no responsibility for errors or omissions. Neither is any liability assumed for damages resulting from the use of the information contained herein.

User serviceable spare parts are available upon request from:-

Magnex Scientific Limited
The Magnet Technology Centre
6 Mead Road
Oxford Industrial Park
Yarnton
Oxon OX5 1QU, UK

$C\!\!\in$ NOTICE

Marking by the symbol $C\!\!\in$ indicates compliance of this device to the EMC (electromagnetic compatibility) and LV (low voltage) directives of the European Community. This unit is to be installed and operated as detailed. Any modification or maintenance procedure undertaken which is not approved by Magnex Scientific Ltd could nullify the $C\!\!\in$ marking of this product and lead to prosecution. A 'declaration of conformity' in accordance with the above directives has been made and is located at Magnex Scientific, Yarnton, Oxfordshire, UK.

3. DESCRIPTION AND OPERATING PRINCIPLE

This is to be fitted to a magnet which is nominally zero liquid helium boil off, i.e. it is closed cycle. Such systems will typically incorporate a cryo-cooler. The **E5083M** controls the helium gas pressure to be positive with respect to atmosphere by using a heating element to boil off helium liquid.

Information is shown to the user on a two line LCD display and there is a 5 button keypad to allow settings to be changed. The three operations accessible via the front panel are (a) adjustment of the helium gas working pressure, (b) to switch to a rapid sampling mode for use when liquid helium refill is taking place and (c) to mute the audio alarm signal.

In normal operational display of data is static. In the event of an alarm or error condition, **E5083M** changes the normal message display sequence by alternating the normal display with the errors or alarms.

The detailed messages appearing via the LCD screen will depend upon which internal system parts of the E5083M have been selected for operation with a particular magnet.

If for any reason the parameter being displayed in the current part of the display cycle is out of tolerance or in error, the lower right hand part of the display will show the word "Error" and the red front panel LED will be illuminated.

During the time period whilst the display is showing an error condition, an internal acoustic sounder will sound.

For more information relating to how **E5083M** responds to errors please see the section entitled ' Diagnosing problems. '

Connecting E5083M to a magnet system

Connections are made via the magnet cables / gas pipe as required for the specific installation:-

Helium level cable	to "Helium"
Helium gas pressure pipe	to "Gas port 'A' "
Gas heater cable	to "Gas Heater"
Thermal sensor cable	to "Cernox"
PC	to "Console" NB Not normally connected to a PC

No cable should be connected to "Aux Input", "Relay Out".
No pipe connections should be made to Gas Ports 'B' or 'C'
Gas Port 'B' is used to measure atmospheric pressure and no gas flows in or out of this port

Gas Port 'C' is not connected internally.

The **E5083M** can measure the following items:
(a) Cryostat pressure
(b) Atmospheric pressure
(c) Helium level for two independent probes
(d) Thermal sensor reading for two independent sensors

The Helium level probes, thermal sensors may be enabled or disabled as required by the magnet system.

When power is applied, the **E5083M** will read the helium liquid level. This process will typically last between 10 seconds. The parameter display screen will then show the helium level, pressure of the helium vessel, thermal sensor temperature the gas heater on time. Also shown is an asterisk if the gas heater is ON. If the 'Right' key is pressed the display will show the helium level for the secondary probe, atmospheric pressure and secondary thermal sensor temperature.

When in the menu system, **Up** and **Down** buttons move between menu items. **Left** and **Right** buttons adjust a value, **Centre/Enter** accepts that value. If an entry is left incomplete or the menu system is not exited, a time-out of approximately one minute occurs.

Pressure adjustment
Press '**Centre/Enter**' then '**Down**'. '**Left/Right**' to alter the value.
Unit is mB and the step size is 1mB. When the operating pressure is adjusted via the front panel an automatic adjustment is also made to the upper and lower pressure alarm settings. These are both set five mB above and below the operating pressure.

Helium Fill mode
Press '**Centre/Enter**' then '**Down**', '**Down**', '**Centre/Enter**'. '**Left/Right**' to later the state.
This turns On or Off the fast sample action which occurs approximately every 40 seconds as required when helium filling. This has a 90 minute time out period after which normal samples on an 8 hour basis occur.

The user should not change any parameter of the E5083M without prior approval of Magnex Scientific Ltd. At the time of installation of the magnet all parameters will be correctly set by Magnex Scientific personnel. Similarly any error condition indicate by the instrument must be communicated to Magnex Scientific Ltd who will advise on the correct remedial action.

To mute an audible alarm condition
To silence the audible alarm, whilst it is active, press the front panel **down arrow** key pad. Hold the key pressed for approximately 5 seconds and release it. The sounder will be silenced. A message will be automatically added to the Error Message stream as displayed on the LCD screen, to the effect that the audible alarm is muted. When the alarm situation has been corrected the mute is automatically reset to be off, thus enabling any subsequent audible alarm.

4. SPECIFICATION

Mains input voltage	:	100 - 230V ~
Mains input power (max)	:	75VA
Mains input frequency	:	50-60 Hz
Fuse rating	:	T2AH250V
Gas port pressure	:	1150hPA absolute max
Gas Heater output voltage	:	24V max
Gas Heater output current	:	800mA max
Gas Heater output power	:	12W max
Isolated RS232 connection (9D socket)	:	9600 baud, 8 bits, 1 stop, and no parity; see section 7 also.
Helium Probe Input Connector	:	9 way 'D' socket
Helium Probe resistance	:	$0.2\text{-}0.05\,\Omega/mm$

The probe wire resistance varies from batch to batch. If the exact probe resistance is required please contact Magnex Scientific Limited with the probe serial number.

Excitation current probe	:	80-245mA dependent upon wire resistance
Probe length	:	100mm to 2000mm
Thermal sensor Input connections	:	9 way 'D' socket

Environmental conditions

The equipment is designed to be safe under the following conditions:

Ambient temperature range	:	10°C to 40°C
Relative humidity range	:	30% to 95% non-condensing
Atmospheric pressure	:	700 hPA to 1060hPA
Equipment classification	:	Class 1

5. DIAGNOSING PROBLEMS

E5083M   Error table

Problem	As detected by E5083M	Alarm result	Notes
Slow helium leak to atmosphere	Falling helium level. Apparent increase in cooler efficiency.	Low helium level but not immediately. Pressure may be correct, initially.	After a period of days or weeks. Gas heater activity may well appear to be normal but in fact will be slightly more active.
Fast helium leak to atmosphere	Falling helium level, quite soon. Inability to maintain pressure	Low helium level, sooner rather than later. pressure likely to fall below alarm point	Period of hours or few days. Gas heater likely to be on 100% time.
Failed gas heater resistive element, open circuit.	Hardware failure of gas heater	Heater hardware failure is detected status shows " ERROR "	Within three seconds if and only if the heater should be active
Failed thermal sensor - open circuit	Thermal hardware error.	Thermal hardware failure is detected	Within three seconds if and only if the thermal sensor should be active
Cooler failed or low efficiency.	Pressure rises Thermal reading may rise	Over pressure alarm may be tripped if rise is sufficient. Over temperature may be tripped	Status changes to " ERROR " when any one of the factors over-steps the trip level Gas heater will usually be off 100% time if cooler has failed
Disconnected helium cable	Helium hardware error	Helium hardware failure is detected	Detected one second after a helium read is attempted.
Disconnected thermal sensor cable	Thermal sensor hardware failure is detected	Thermal sensor hardware failure is indicated.	Within three seconds
Open or disconnected gas pipe	Pressure same or close to atmospheric Falling helium level	Low pressure alarm very likely Helium low alarm, later	Within three seconds

Disconnected gas heater	Hardware failure of gas heater	Heater hardware failure is indicated.	Within three seconds after E5083M commands gas heater " ON "
Blocked gas pipe	Pressure may be affected measured helium pressure does not rise	Likely that a pressure error is triggered	
Burst disc, burst.	Burst disc sensor detected as burst	Pressure will fall Likely that a pressure error is triggered	Magnet *may* have quenched
Disconnected burst disc or open circuit cable	As above		
Non cycling gas heater	Gas heater fixed on or off for longer than about 2 hours, and has not cycled on - off in that time	May be a helium leak if the heater is on for a long period. May be lack of cooling efficiency if the heater is off for a long period	Can occur post helium fill, prior to re-pressurizing or during installation phase
Cryo-cooler low efficiency	A cooler on to off ratio that exceeds the set alarm level	Alarm LED active, sounder active, if not muted.	

6. HARDWARE ERRORS

Helium probe hardware errors

E5083M tests the continuity of the heater current path within the helium probe(s) **only** when a particular probe is active.

Normally the helium liquid level is measured three times per day, at 01:00 hrs, at 09:00 hrs and at 17:00 hrs, all being with respect to the internal real-time clock of the **E5083M**. If a hardware error is detected, it is stored and will be displayed as an error message indicating a helium probe hardware error, together with which channel is in error. This error will not be cancelled by the **E5083M** until the next level measurement is made, 8 hours later. This does not apply when the **E5083M** is set to be in helium fill mode, during which the probe(s) is tested every read, being approximately at one minute intervals.

Thermal sensor hardware errors

E5083M tests the continuity of the thermal sensor(s) during each measurement cycle, i.e. every three or so seconds. If when tested, a hardware error is detected, it is stored and will be displayed as an error message indicating a thermal probe hardware error, together with which channel is in error.

Gas Heater hardware error.

E5083M tests the continuity of the gas heater resistive element every few seconds but this test **only** occurs if the heater is supposedly ON at that time. If the heater is OFF, a fault will not be detected until the heater is next commanded ON.

In normal use the gas heater will cycle continuously and will change state On to Off several times during an hour.

7. SETTINGS FOR HYPERTERMINAL

All control and setting of HyperTerminal is achieved via the **File, Properties** option. Please choose the appropriate COM channel number. COM2 is shown below; you may need to use COM1, COM2 or COM3 etc. On the first screen, i.e. this page, left, click on <u>Configure,</u> to see the screen as shown to the right. On the second screen, i.e. next page, left, click on <u>ASCII Setup,</u> to see the screen as shown bottom right.
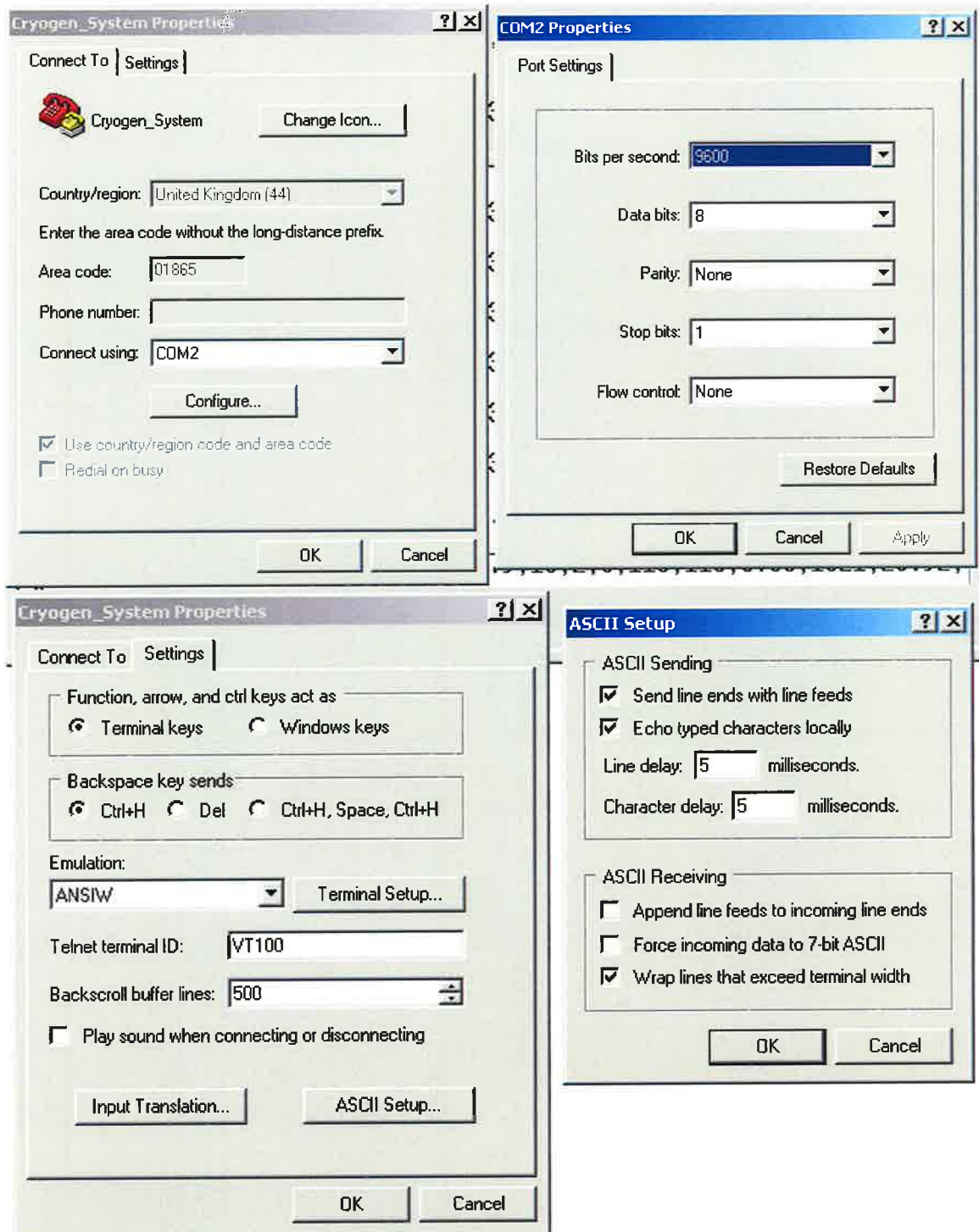
Serial cable pin connections.

Only the pins shown in the table below should be connected.

E5083M 9 way skt	PC 9 way skt
pin 2	pin 2
pin 3	pin 3
pin 5	pin 5

8. COMMAND INSTRUCTION SET

All commands are terminated with CRLF (i.e. press ' enter ')
All command letters are case sensitive; back-spacing is not allowed.

General Commands

Command	Function
A	Turn Sounder On if error exists
K	Turn Sounder Off if error exists NB Pressing the front panel Down Arrow key will silence the alarm. Press it for several seconds, <u>whilst</u> the alarm is audible
ynn	Set year (00 to 99)
Mnn	Set Month (0 to 12)
Dnn	Set Date (0 to 31)
dn	Set Day (1=Sun, 2=Mon, 3=Tue, 4=Wed, 5=Thu,6=Fri,7=Sat
hnn	Set hours (0 to 23)
mnn	Set minutes (0 to 59)
snn	Set seconds (0 to 59)
BDY	Enable Burst Disk
BDN	Disable Burst Disk
r	Restart software

Helium Commands

P1Y	Switch Probe 1 On
P1N	Switch probe 1 Off
P2Y	Switch Probe 2 On
P2N	Switch probe 2 Off
PL1nnnn	Set Probe Manufactured length where nnnn is length in mm including leading zeroes
H1Lnnnn	Set Helium Alarm level where NNNX is length in mm including leading zeroes
H1Tnnn	Set Heater time where nnn is time in secs including leading zeroes
H1Cnnn	Set Heater Current where nnn is current in mA including leading zeroes
PR1nnnmm	Set Probe Resistivity where nnn.mm is resistivity in ohms/m including leading zeroes
PL2nnnn	Set Probe Active length where nnnn is length in mm including leading zeroes
H2Lnnnn	Set Helium Alarm level where NNNX is length in mm including leading zeroes
H2Tnnn	Set Heater time where nnn is time in secs including leading zeroes
H2Cnnn	Set Heater Current where nnn is current in mA including leading zeroes

PR2nnnmm	Set Probe Resistivity where nnn.mm is resistivity in ohms/m including leading zeroes
HMY	Set Helium Fill mode On NB Level is measured every minute. On display the letter 'F' is displayed to the right of ' Helium1 or 'Helium2' during the fill mode period.
HMN	Set Helium Fill mode Off
HN	Read Helium level

Thermal Channel Commands

X1Y	Switch Thermal channel A on
X1N	Switch Thermal channel A off
X2Y	Switch Thermal channel B on
X2N	Switch Thermal channel B off
CNAnn	Set number of entries in thermal sensor data table channel A to nn+1
CNBnn	Set number of entries in thermal sensor data table channel B to nn+1
T1xxy	Set thermal channel A alarm level where xx.y is in degs K,
T2xxy	Set thermal channel B alarm level where xx.y is in degs K,
CEAnnkkkRRRRR	Set thermal sensor table A entry where nn is table index value starting from 00 For software versions 1 to 4 where kkk is x.xx degs K For software versions 5 onward where kkk is xx.x degs K where RRRRR is Ohms with leading zeroes
CEBnnkkkRRRRR	Set thermal sensor table B entry where nn is table index value starting from 00 For software versions 1 to 4 where kkk is x.xx degs K For software versions 5 onward where kkk is xx.x degs K where RRRRR is Ohms with leading zeroes

Pressure Commands

pnnnn	Set required pressure in mB
HPnnnn	Set high pressure alarm in mB
LPnnnn	Set low pressure alarm in mB

Gas Heater

CLnn	[00..99] Gas Heater Alarm lower limit Please note that a CL00 will turn OFF the cryo-cooler alarm function.

Request Command

Command	Function	Reply
?	List Help	Text String displaying Command Set
t	Display Clock	Text String indicating Date and Time
W	Read Parameters Concise	Text String of parameters
U	Read Parameters Verbose	Text String of parameters
R	Read log	Tab delimited file of log entries
EH	Read errors	List of errors
CTA	Read Thermal sensor data table Channel A	List of Table entries
CTB	Read Thermal sensor data table Channel B	List of Table entries

N.B. for early single thermal channel version use CT, CE and CN.

9. USING HYPER TERMINAL TO UPLOAD LOGGED DATA

Connect lap - top or other PC to E5083M, thence run Hyper Terminal,

Click on **Transfer**, select **Capture Text**.

Use browse to declare a suitable log location and file name.

Click "**Start**" in the same general dialogue box.

Type **R**, <RETURN>this command causes the logged data to be up-loaded.

When the log upload has ended do as follows:-

Click on **Transfer**, select **Capture Text**.

Click "**Stop**" in the same dialogue box.

To view the data use a suitable PC spreadsheet program.